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MANUAL FOR BALLOON CUTTERS.

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MILITARY INTELLIGENCE DIVISION,
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WAR DEPARTMENT,
WASHINGTON, October 29, 1918.

The following pamphlet, entitled "Manual for Balloon Cutters," is published for the information and guidance of all concerned.

(062.1 A. G. O.)

BY ORDER OF THE SECRETARY OF WAR:

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INTRODUCTION.

The cutter specialists of the balloon troops have general supervision over the repairs and maintenance of all the fabric materiel.

The object of the present handbook is to teach them:

First.—To become well acquainted with the materiel with which they have to deal.

Second.—To keep it in good working order in the field.

Third.—To repair it properly.

It will serve as a basis of the theoretical instruction given in the field to students who are studying to become specialists. This theoretical instruction is given during periods of inaction.

It will be found equally useful to the balloon officers.

As they are responsible for the materiel and as it is their duty to direct constantly and in the most minute details the work of all the specialists under their command, they will find in this book a quick and accurate work of reference on all the different details of practical execution.

A supplement, especially intended for them, completes this book. It contains more detailed information about the principal questions under discussion and especially about the raw materials and the methods of construction.

MANUAL FOR BALLOON CUTTERS.

CHAPTER I.

DESCRIPTION OF BALLOONS.

Balloons are divided into two large classes:

Balloons carrying personnel.

Balloons for different purposes.

They belong to one of two models:

1. Elongated balloons (only used in the service).

2. Spherical balloons (now used only to make free ascensions).

We shall first describe the elongated balloons, then the spherical ones.

ELONGATED BALLOONS.

The essential parts of the elongated balloons are:

1. The so-called envelope of the balloon.

2. An inner ballonet, which is made for the purpose of keeping the form of the balloon.

3. An automatic valve, which is to prevent an excessive pressure on the inside.

The models marked with the letters L, M, N, P, R, S, T, G and H belong to this type.

Type M (models H and G, types of German origin, which are no longer used by the French Army,¹ will be summarily described later).

EXTERIOR DETAILS OF THE ENVELOPE.

(a) *The Rudder* (figure 2).—The rudder is composed of three pneumatic pads. The exterior part of each pad is attached to the envelope by two sets of interior triangular ropes. The manner of attaching these ropes varies according to the type.

¹Except the type G used as a target balloon.

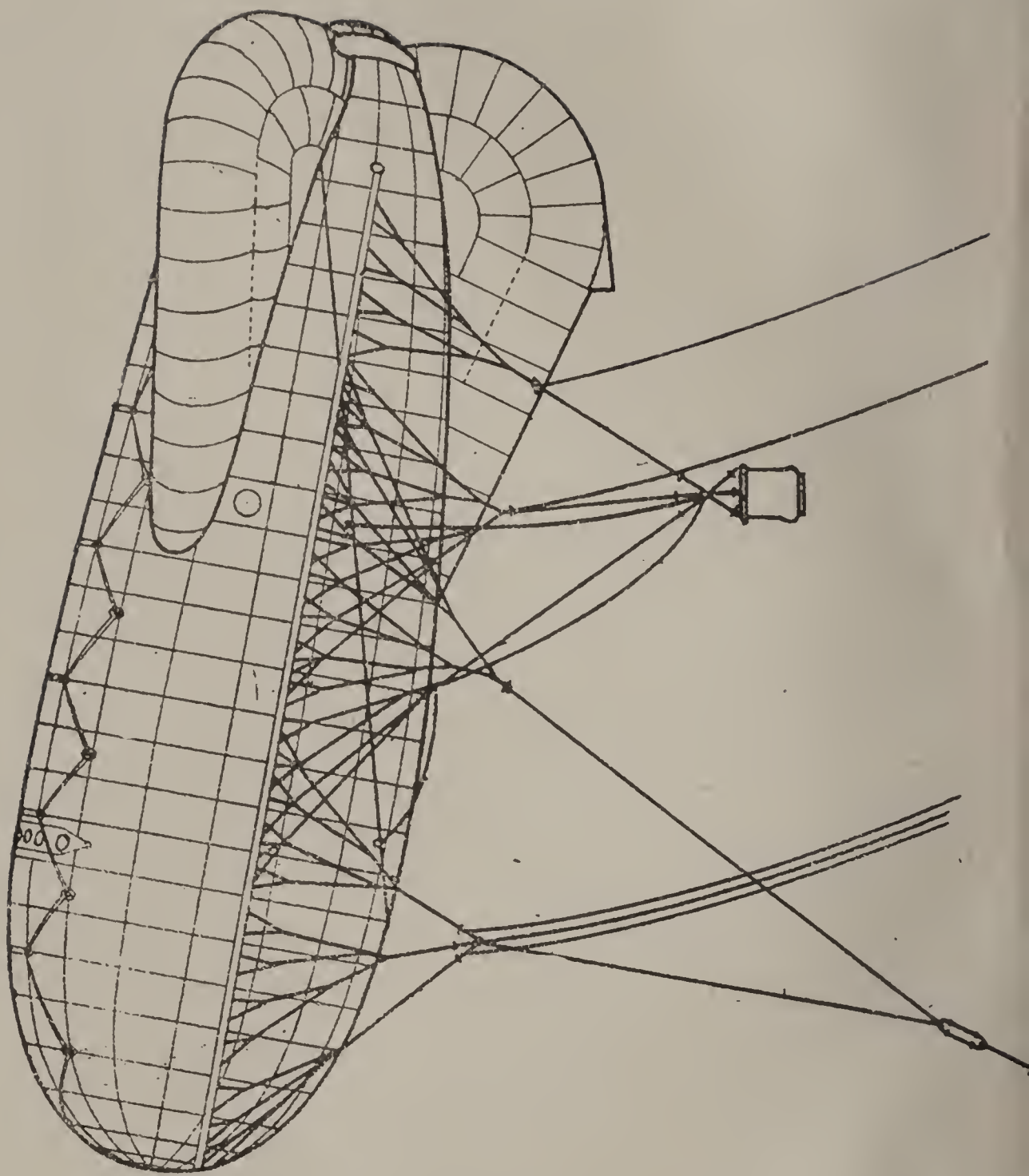


Figure 1.
Form.

The elongated balloons have the form of a continuous keel, having the midship frame toward the first quarter (figure 1).

The lower pad receives the air either through a deflating sleeve or through an orifice communicating with the ballonet.

The upper pads receive the air from the lower pad through two inlets or through an inner tube situated in the back part of the keel.

The balloon is deflated by means of special orifices (deflating sleeves of coups de poing), placed in the back part and by deflating cords attached to the exterior of the pads by means of cross bracings of fabric fastened in three layers. The dimensions of the openings are such that a man can pass through

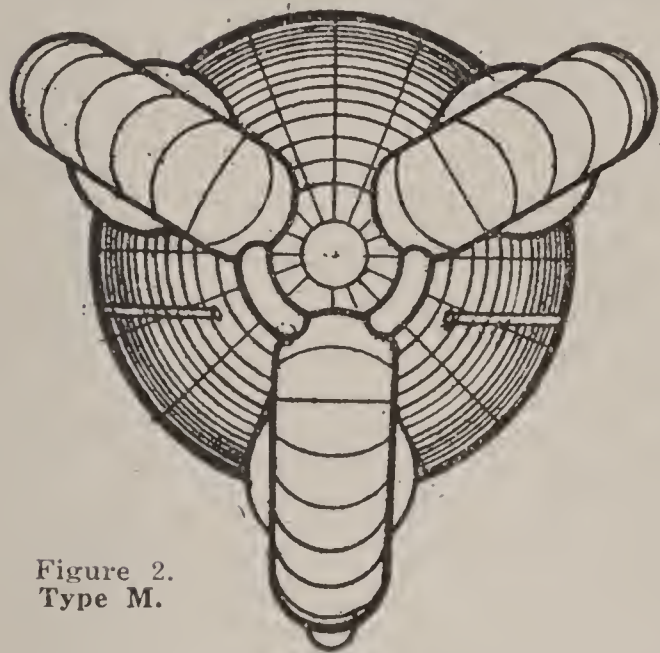


Figure 2.
Type M.

them. On the lower pad an eyelet facilitates the folding of the balloon by permitting the air to escape. On the upper pads two draining eyelets assure the drainage of rain water and a reenforced circular orifice permits the air to escape when the balloon is collapsed.

(b) *The Rigging Band.*—The rigging band, upon which the rigging system rests, is composed of a structure made of double fabric (2 thicknesses fastened together (*a a'*) folded around the toggle (*b*). The surface on which the toggle rests is provided with a belt of one-ply fabric, fastened the whole length of the surface.

The rigging band is glued and sewn with three stitches on the previously reinforced part of the keel (*b*) a little below the equator. The stitches are made airtight on both sides (*d d'*).

The lower part of this reenforced section is perforated with small elliptical perforations of about 0.035 m. by 0.010 m., permitting the line, which is attached to the toggle, to pass through. It has eyelets for lacing placed on both sides of the toggle in such a way that they restrict without preventing its movements.

(c) *Bagging down net* (figure 4).—A net of bands, with large meshes, which is to tie down the balloon, is attached to the upper part and has, at the top, on the exterior, metallic rings provided with ropes to which the bedding down ropes are attached.

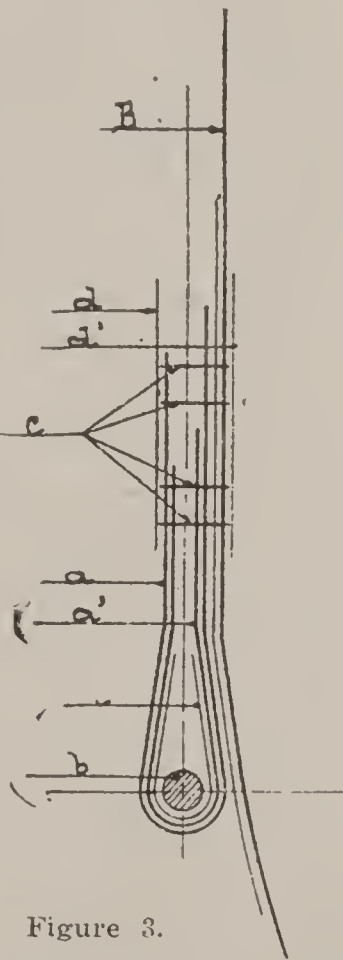


Figure 3.

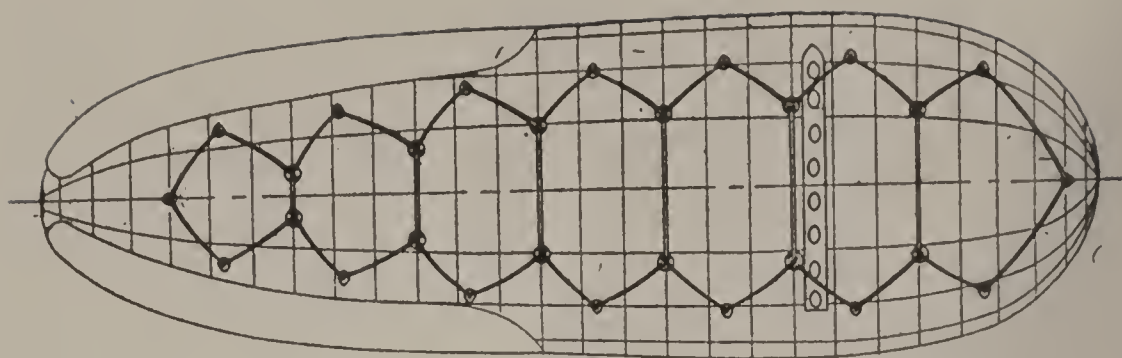
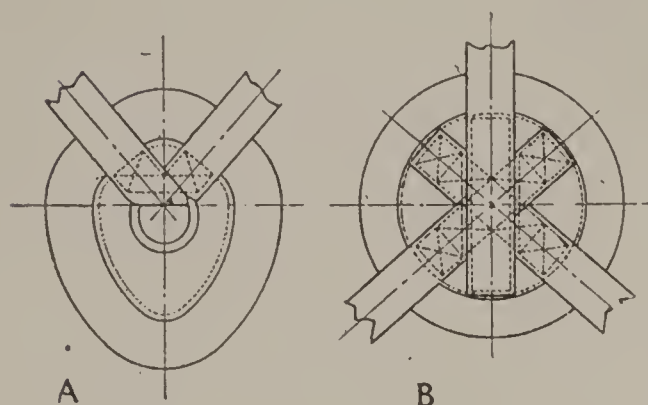


Figure 4.



A and B.—Detail of the Structure of the Belt.

The net is fastened in two coatings and covered with a band of single-ply fabric fastened in two coatings up to about 10 centimeters from the rings.

(d) *Ring of the valve* (figure 5).—The ring of the valve is a circular reinforcement of the opening of the valve and consists of two washers (*a a'*) 2 thicknesses of double-ply fabric fastened down and having an internal diameter equal to that of the opening. These two washers fastened, one on the interior and the other on the exterior, are attached to the envelope (B) by means of five concentric stitches (*c*) airtight on both sides (*d d'*). The ring is perforated with 12 perforations, which are made for the fastening bolts of the valve.

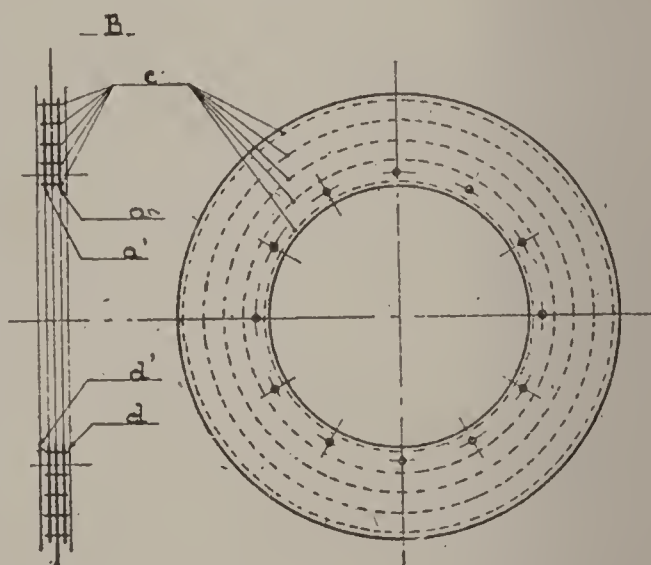


Figure 5.

(e) *Inlet* (figure 6).—The inlet is inserted in the elliptical orifice, made for this purpose, by means of an enlargement obtained through indentations (*a a'*) which are fastened (glued) to the inner surface of the envelope (B) and which are secured by two stitches (*c*), airtight on both sides. The

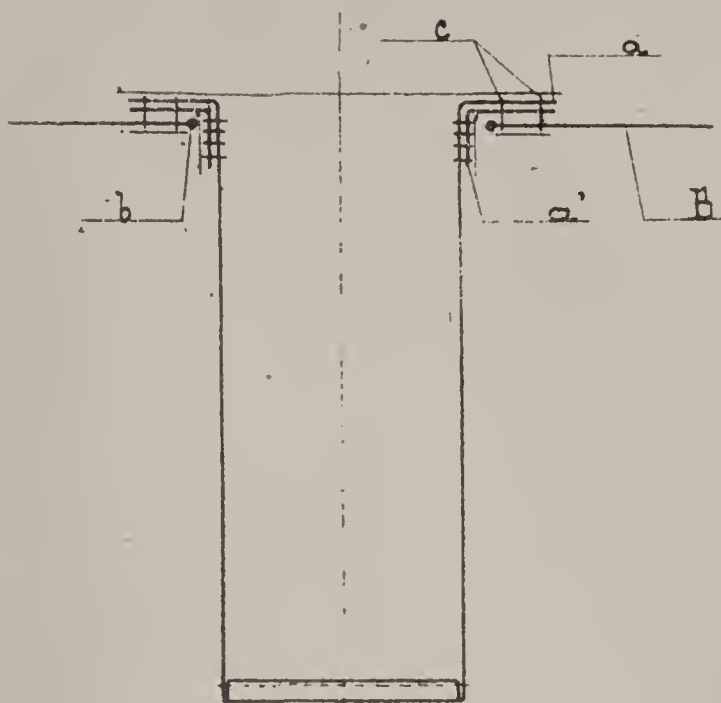


Figure 6.

One for the return of the automatic control.

They consist of a grooved tube T, ending in a splay. This tube is inserted in a small "chimney" of fabric (a), the base of which serves as a seat of the splay.

The part thus fitted in is inserted either by force through a small orifice or through a radial orifice and fastened by the base to the inner surface of the envelope (B). The tightness is assured by two washers of single-ply fabric (d d'), of a different diameter, superimposed and fastened (glued) to the interior. It has a safety device consisting of

orifice has previously been reinforced by a pad (b) made by a strap of tape inserted in a washer of double-ply fabric doubled upon it. When the inlet is closed, it is inserted into the orifice, where it is held by a disk of rubberized fabric, buckled by lacings, on the circumference of the orifice.

(f) *Sleeves* (figure 7).—The sleeves are three in number:

One for the control of the ripping.

One for the hand control of the valve.

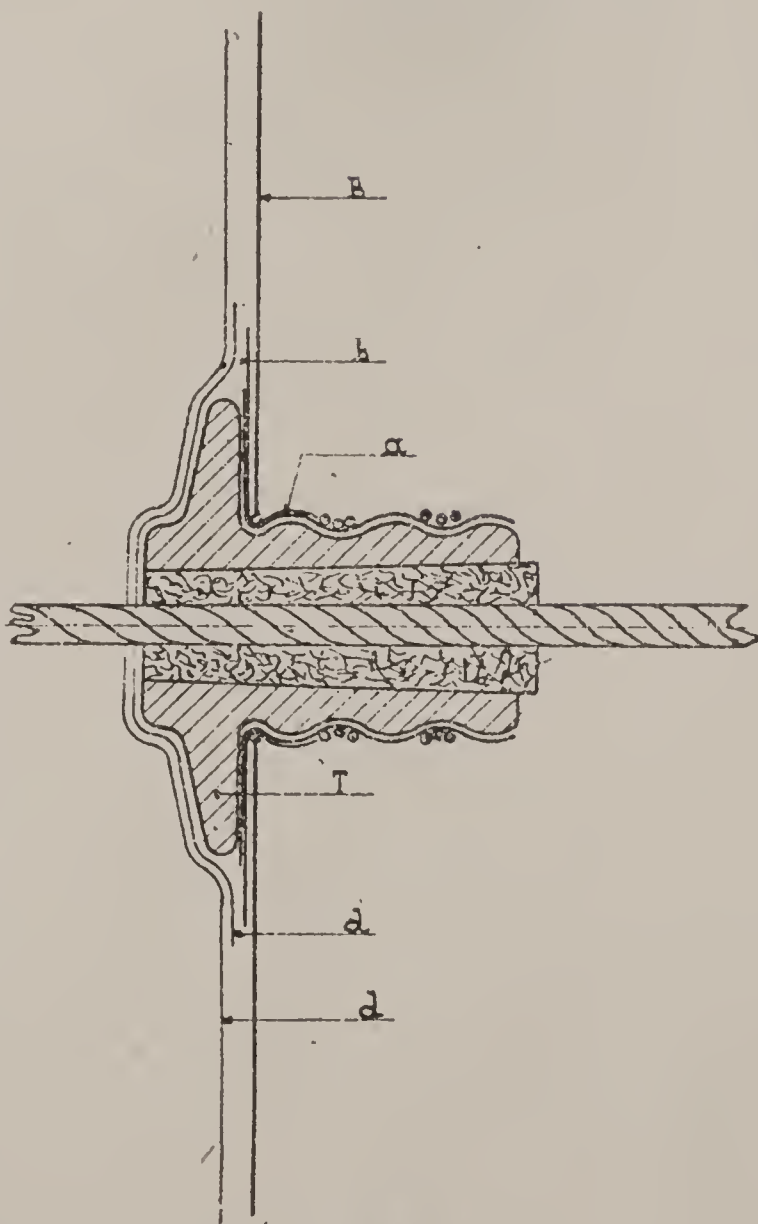


Figure 7.

a ring placed in two cross bracings (made of a band of fabric rolled and overcast) attached to the balloon by means of a disk of double fabric fastened down and having two coatings, upon which the cross bracings are sewn (the sleeves of a less recent model are of wood or horn).

(g) *Deflating sleeves*.—The air enters the ballonnet or rudder, according to the type, through an elliptical orifice edged by a pad similar to that of the inflating orifice.

The deflating sleeve proper, through which the air enters, is in the shape of a half cup. It is composed of the same fabric as the part upon which it is fitted (one-ply for the rudder, double for the balloon).

It is fitted:

(a) On the circumference with glue and two seams, air-tight on both sides.

(b) At its two rectangular extremities (figure 8) by means of two disks of fabric ($a\ a'$) split along a radius and fastened respectively:

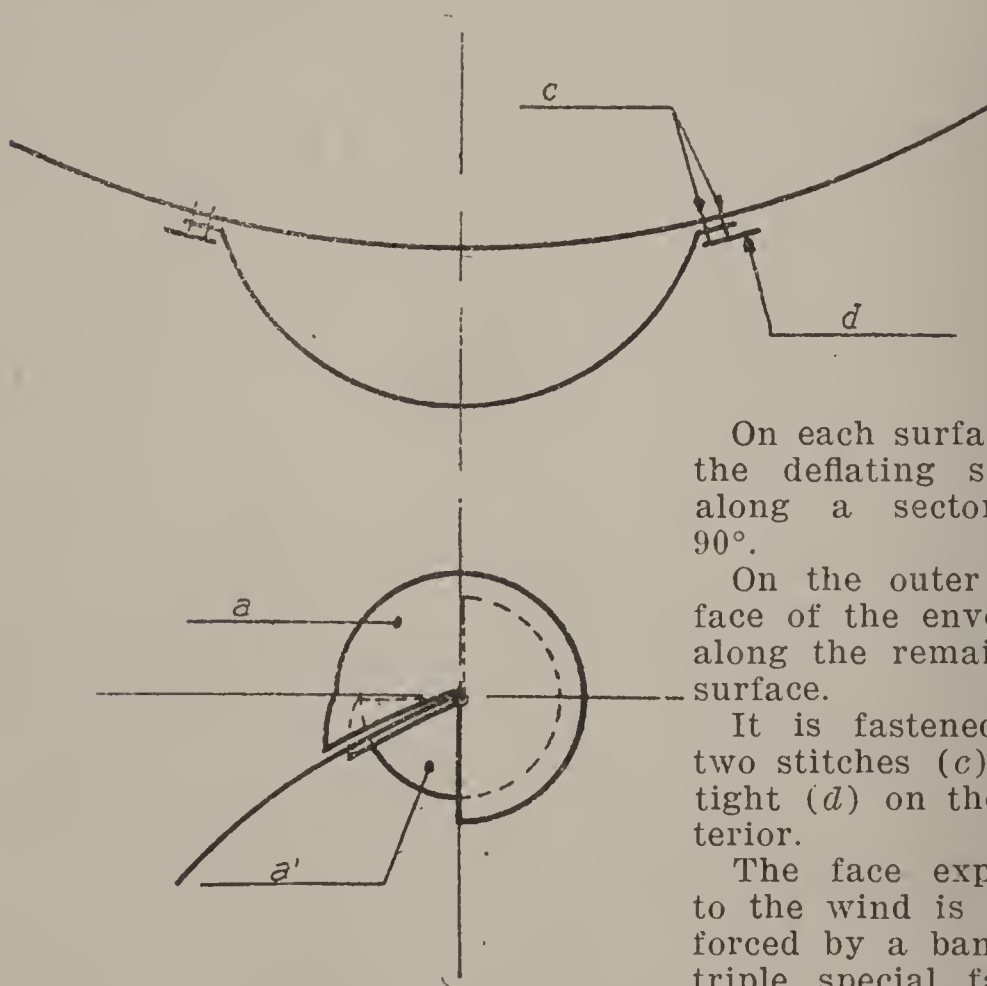


Figure 8.

On each surface of the deflating sleeve along a sector of 90° .

On the outer surface of the envelope along the remaining surface.

It is fastened by two stitches (c) air-tight (d) on the exterior.

The face exposed to the wind is reinforced by a band of triple special fabric or, in the most recent models, by an air chamber enclosed

in a band of one-ply fabric, glued or stitched along the length of this face.

(h) *Windows* (figure 9).—The interior parts of the machinery can be seen through windows, the number of which vary according to the types. They consist of a disk of transparent material (a) fastened between two aluminum washers (b b') and joined by bolts.

To insert them an opening is made at a place in the envelope (b), previously reenforced by a washer of double fabric (c), fastened on the inside. The diameter of the opening is equal to the internal diameter of the metallic washers. Assembling bolts are placed around the passage holes. The tightness is assured by rubber washers (f) inserted between the fabric and the washer fitted on the inside and a large washer of one-ply fabric glued on the surface.

(i) Exterior arrangements of the ripping.

In the upper part of the balloon, near the main frame, elliptical openings are made, edged with cords, against which the ripping panel of the ripping is placed and which allows the gas to escape when the panel is torn (see figure 4). An eyelet made in the lower part assures the drainage of

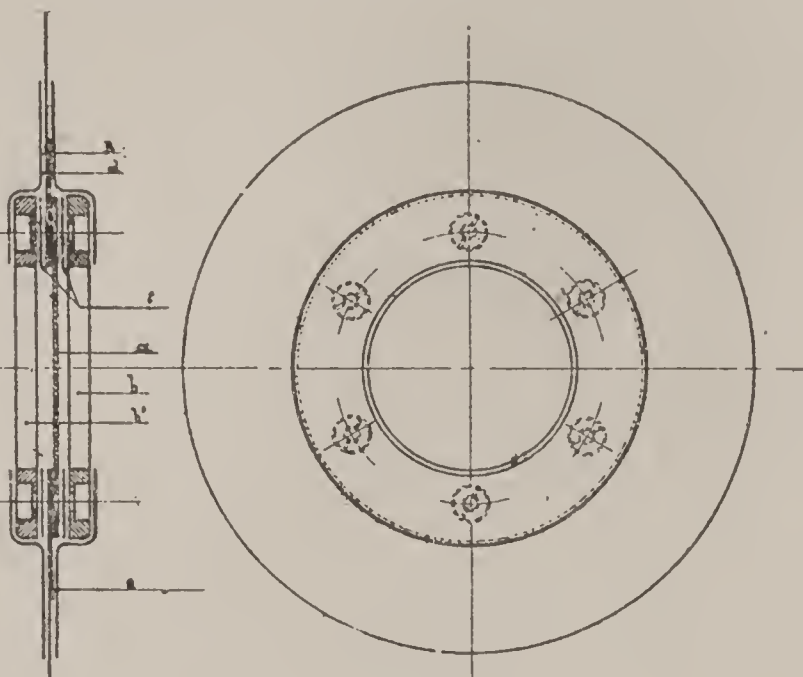


Figure 9.

the rain water. These openings vary in number according to the types. They are distributed at the ratio of two in each panel.

INTERIOR DETAILS.

(j) *The ripping panel*.—The ripping panel is of double fabric. It is placed over the openings described above and forms a flap valve. At the end of it is an eyelet and a toggle on which the fabric is doubled and fastened by three seams.

It is glued and sewed on the inner surface of the envelope (using a special seam, three stitches to a centimeter), air-tight on both sides.

(k) *Ballonet*.—The ballonet, made of double-ply fabric, has on the external surface of its upper part, called "diaphragme," a system for fitting the automatic valve control, which varies

according to the types (bands or rings). The air enters, according to the types, either through a deflating sleeve or through an orifice communicating with the rudder. An eyelet facilitates the escape of the air.

(1) *The top valve* (figure 10).—The top valve, to which the valve cone of the return of the automatic control is attached, consists of a ring forming a circular discontinuous rigging band, which supports 8 toggles. This rigging band, made of a double fabric, is doubled again around the toggle and covered on the inside with one-ply fabric and is glued to the inner surface of the envelope and stitched by three concentric seams, airtight on both sides.

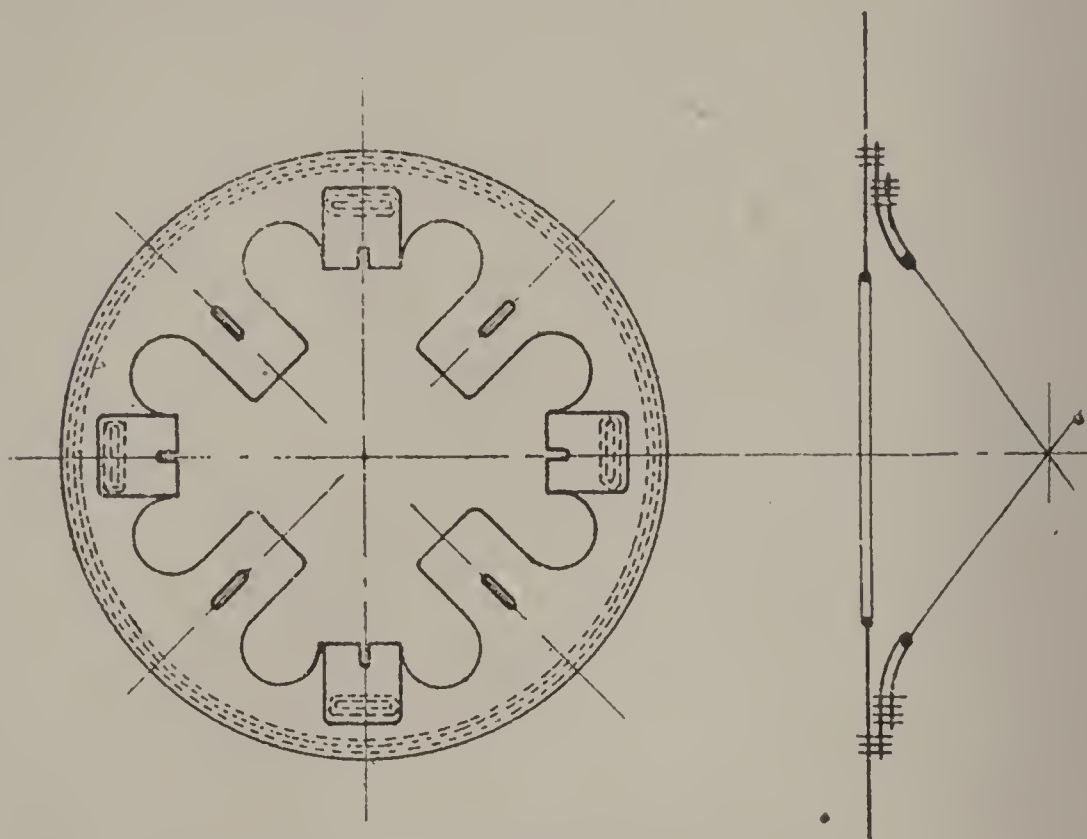


Figure 10.
Straight Flap. Flap Sewed Down.

DIFFERENT TYPES OF ELONGATED BALLOONS.

Certain balloons, which have slight variations from the characteristic types given here, are to be found in use. These differences arise either through attempts at modification or through details introduced by the manufacturer.

BALLOON L.

Balloon L, the first application of the principle upon which the elongated French balloons are constructed, has special characteristics. Moreover, it is no longer used in the service.

Dimensions: Length, 24 meters. Diameter (at the main frame), 8 meters.

Rudder.—Consists of a single pad which entirely covers the rear part of the balloon on a longitudinal plan. The inner ropes are attached, by means of a rigging band, made of two thicknesses of double fabric doubled again on the toggle. This rigging band is glued and sewed (by four seams, airtight on both sides), to the fabrics of the balloon and ballonet.

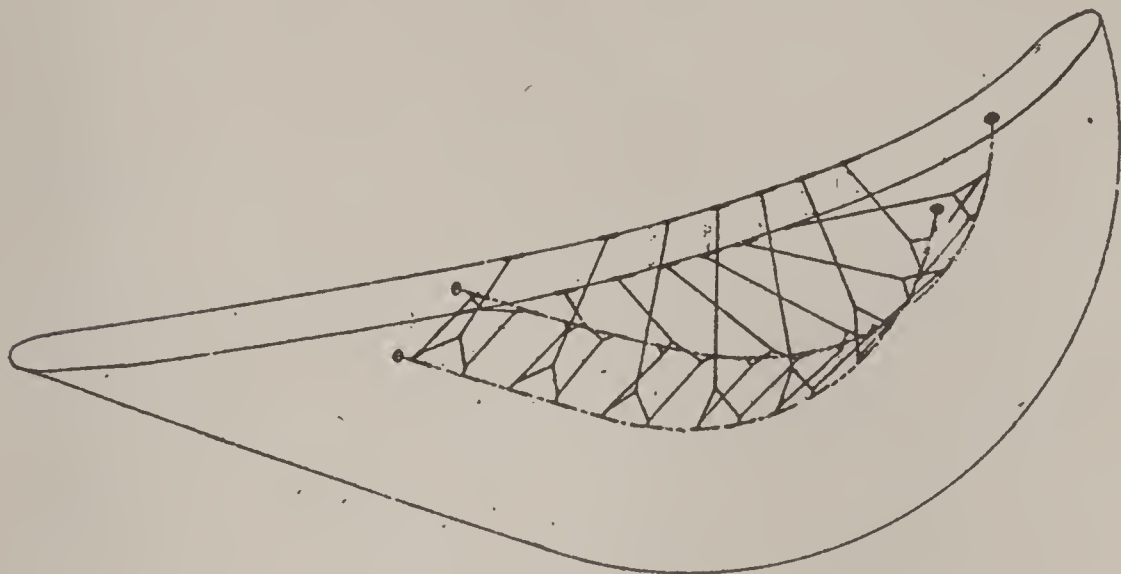


Figure 11.

Type M.

The balloon is inflated by means of a deflating sleeve situated in the lower part of the balloon and two deflating sleeves on the sides of the pad, at the height of the axis.

Inlet.—In the front.

Valve collar.—On the right side, towards the rear, about 2 meters above the rigging band.

Ripping.—Eight holes for 4 panels.

Ballonet.—In the rear. The air enters by means of an orifice communicating with the rudder.

The automatic control is fastened by means of four bands of straps (0.055 m. wide and 0.027 m. long), sewed with a saddler's stitch on 0.10 m. of both sides with a ring 0.035 m. high, which the thread enters. The seams are airtight on the inside and the outside.

False Valve.—On the left side, symmetrical with the valve collar, in a longitudinal plane.

Windows.—Two, one for the balloon, one for the ballonet.

BALLOON M (see figure 1).

Dimensions: Length, 25 m. Diameter (at the main frame), 8.15 m.

Rudder.—Three pads. Attachment of ropes similar to that of L. The air enters through a deflating sleeve on the lower pad. Deflation is made by means of two sleeves having a diameter of 0.40 m. and placed behind the upper pads.

Inlet.—In the front.

Valve collar.—On the right side, toward the rear, about 1.50 m. above the rigging band.

Ripping.—Eight holes for 4 panels.

Ballonet.—In the rear. Same characteristics as that of L.

False valve.—On the left side, symmetrical with the valve collar, in a longitudinal plane.

Windows.—Two, one for the balloon, one for the ballonet.

BALLOON R.

Dimensions: Length, 27.50 m. Diameter (at the main frame), 8.30 m.

Rudder.—Three pads. Attachment of the inner ropes:

(a) To the balloon by means of a rigging band like that in L.

(b) To the pad by means of crowsfeet of elliptical form (figure 12), having an extension made of a piece of double fabric 0.32 m. by 0.25 m. (a) doubled by a piece of tent canvas 0.20 m. by 0.16 m. (b) and a belt (e) 0.22 m. by 0.03 m. stitched on the double fabric, along the axis, with a rectangular stitching.

(c) Two diagonal cross seams (c').

The belt is stitched with a seam of 0.16 m. on both sides of a central hook (f) which is 0.03 m. high and through which the thread passes. The end of the hook is fastened by means of a seam in which saddler's stitch is used (c').

The crowsfeet are glued in three layers, the belt sliding transversely on the middle seam of the panels (b b'). The air enters through a deflating sleeve on the lower pad. Deflation is made by means of two sleeves, which have a diameter of 0.40 m.

Inlet.—In the front (in the rear in certain balloons constructed at first).

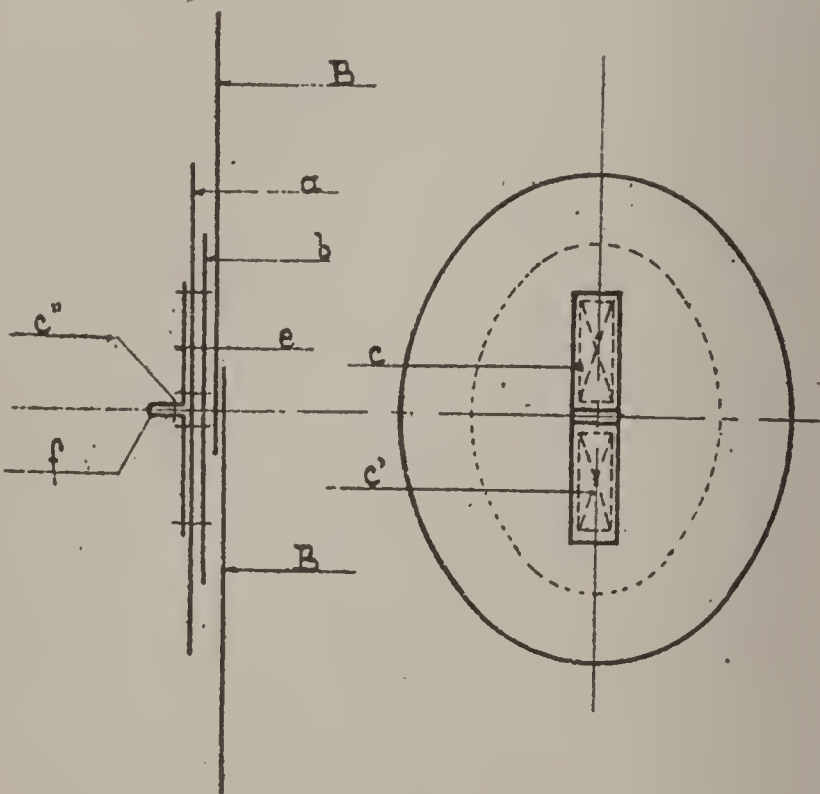


Figure 12.

Valve collar.—In the front.

Ripping.—Eight openings for 4 panels.

Ballonet.—In the lower fore part of the balloon extending about $\frac{3}{4}$ of its length. Attachment of the automatic control by means of a collar identical with that of the false valve. The air enters through a deflating sleeve situated in the fore part of the balloon and through an orifice communicating with and balancing with the inner pad. The deflating sleeve and the ballonet are provided with two small drainage orifices for the purpose of draining off the rain water. The outer surface of the ballonet does not touch the inner surface of the envelope, consequently there is constantly a space through which the air can easily enter.

False valve.—In the rear.

Window.—Only one window for the balloon, the ballonet is inspected through the deflating sleeve.

BALLOONS P and P².

Dimensions: Length, 25 m. Diameter (at the main frame), 7.45 m. and for P², 8.05 m.

Rudder.—Similar to that of R. The sleeve through which the air enters is provided with a small drainage orifice for draining off the sea water.

Inlet.—On the left side in the last panel held by the rigging band and a little below the latter. A sleeve 15 m. in length and 0.15 m. in diameter, allowing it to float again on the water, is placed in the fore part. It is raised and attached to the bottom of the balloon by means of three cords which enter into two thimbles and a bull's-eye. The thimbles are fastened by means of fasteners similar to the safety cross bracing of the valve command and the bull's-eye is fastened by means of a "splay." The neck of the bull's-eye is inserted in a grommet, the free ends of which are heckled and the fibres of which are methodically spread out and glued between two disks, stitched together by means of a circular seam and several cross seams.

Valve collar.—In the fore part (replaced in certain balloons by a collar similar to that used in spherical balloons and which is to receive a wooden valve of a new model).

Ripping.—Six openings for three panels, the two upper ones and one at the right side.

Ballonet.—Similar to that of R. The air enters, in certain models, through two deflating sleeves, placed close together and separated by a space of 0.20 m., in which the raised reinflation sleeve is located.

False valve.—In the rear.

Window.—Only one as in R.

BALLOONS USED FOR DIFFERENT PURPOSES.

Balloons which are not provided with network, sleeves, window or ripping.

BALLOON N.

Dimensions: Length, 15 m. Diameter (at the main frame), 4.80 m.

Rudder.—Similar to that of R, but without a deflating sleeve. The air enters through an orifice communicating with the ballonnet.

Rigging band.—Similar to that of the other types, but simpler (only one thickness of double fabric).

Inlet.—On the left side, toward the rear, below the rigging band.

Valve collar.—In the fore part.

Ballonnet.—Two ballonets; one in the fore part, similar to that of R, communicating with the lower pad of the rudder. The other in the rear, hemispherical, communicating at the bottom with the lower pad of the rudder and at the top with the upper pads.

False valve.—Attached to the rear of the ballonnet.

BALLOON S.

Dimensions: Length, 8.50 m. Diameter (at the main frame), 3.65 m.

Rudder.—Similar to that of R.

Rigging band.—Replaced by 6 coupling bands, 3 on each side, glued in 3 layers.

Inlet.—In the forepart, slightly staggered on the right of the valve collar.

Valve collar.—In the front.

Ballonnet.—Similar to that of R, but on the outside of the balloon. The valve control is consequently placed in the envelope of the balloon, to which it is attached by means of a fastening (figure 12), for the purpose of reducing the weight, the seams are not airtight.

False valve.—In the rear. The collar is replaced by a crow'sfoot (figure 12).

BALLOON T.

Dimensions: Length, 17 m. Diameter (at the frame), 6.34 m. Same characteristics as balloon N.

TYPES G AND H.

Types of German origin (figure 13).

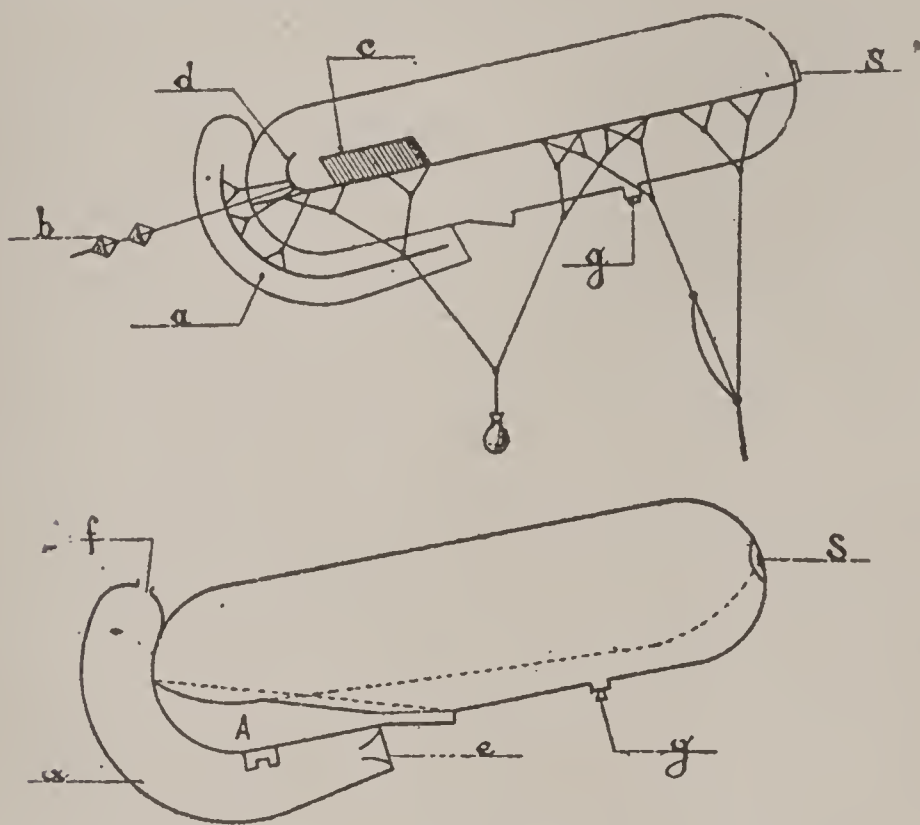
They have the form of an elongated cylinder terminated by two hemispheres. The form is kept invariable by means

of a ballonnet inflated with air (A). The excessive pressure is prevented by the action of a valve (S) opened automatically by the movements of the diaphragm. The balloon is turned in the direction of the wind:

1. By the rudder inflated with air (a).
2. By the tail made of little cup-shaped plates strung on a rope (b).

The angle of slope of the balloon in the wind is diminished by the action of the two ailerons (c), located in the rear at the height of the rigging band and held by adjustable ropes.

Rudder.—A pneumatic pad situated in the rear part of the balloon. The ropes are on the outside and are fastened to toggles held in place by two curved bands (d). The air enters through a funnel (e). The excess air escapes through a tube placed in the upper part (f).



Rudder.

Figure 13.

Suspension rigging band.—*Bagging down net.*—*Valve collar.*—Similar to the same parts of the French elongated balloons.

Inlet.—Fitted in the same way as in the French balloons, but situated under the bottom of the balloon towards the middle (g).

Sleeves (in the type H).—Two, one to control the ripping, the other for the hand control of the valve.

Windows (in the type H).—Three, two for the balloon, 1 in the fore part, 1 in the middle, 1 for the ballonnet.

Ripping (in the type H).—Similar to the ripping of the French balloons, but without the arrangement of elliptical openings on the outside (except in the last models constructed in France).

Ballonet.—In the rear. The ropes are fastened at three points in the same horizontal plane. It is inflated by means of a deflating sleeve. Orifice of communication is on a level with the rudder. It can be inspected through a "manhole," open on the side.

BALLOONS WITH AN EXPANDING ENVELOPE.

Certain models of elongated balloons, of small and medium volumetric capacity, which do not carry personnel and are used for special purposes, have neither ballonet nor automatic valve. The shape is maintained by the overpressure which the gas acquires with the altitude. Excess of pressure is prevented by an automatic increase of volume made by means of expanding folds with an elastic return. This arrangement, adapted in various forms on the different types of balloons described above, consists of eight light rigging bands, which are provided with eyelets, through which the elastic bands pass. These bands yield to a certain strain which opens the fold and brings the balloon back again to its original volume by closing the fold as soon as this strain is released and the pressure decreases (figure 14). These rigging bands are made of one thickness of double fabric glued in 2 layers and sewed by two seams airtight on both sides and which is redoubled on itself in the place where the eyelets are made.

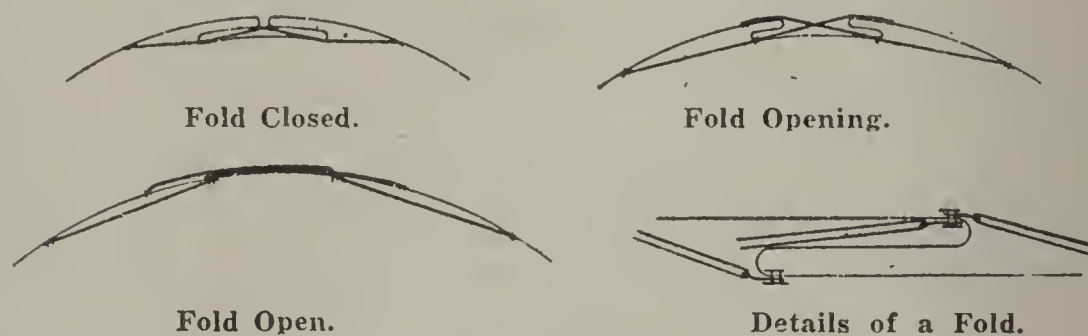


Figure 14.

FABRICS USED.

The fabrics used at the present time for the construction of military balloons are *rubberized cotton fabric* and *calico*. Strapping is used for the bagging down net.

Calico.—Calico, a very strong cotton fabric, is used only in the construction of balloons which are to make free ascensions. It is varnished in order to insure tightness, which it does not have (*see Part II*).

Rubberized fabric.—In the rubberized fabric, used at the present time only in the construction of captive balloons, the

resistance is insured by the fabric and the *tightness* is insured by a very thin layer of rubber.

Use.—Rubberized fabric is used single-ply or double-ply. Single-ply for the construction of the rudders and to insure the tightness of the seams (in the form of bands or *edgings*). Double-ply is used for the construction of the ballonnet and of the envelope which contains the gas and resists the force of the wind and supports the weight of the basket.

Diagonal fabric.—The double-ply rubberized fabric is made of two pieces of one-ply fabric, joined with the rubberized sides together and coated with rubber on the inside or outside, according to the different fabrics. The fabrics are joined along the straight thread or the diagonal thread, depending on the threads of the respective fabrics, whether they are parallel or placed at an angle of 45°.

Only diagonal fabrics are used at the present time. The diagonal to the right is to be distinguished from the diagonal to the left. The direction of the diagonal is to be distinguished like the threads of a screw. The fabric is placed with the *dyed surface up*. If you look at it *endwise*, that is to say, along the longitudinal threads (the warp), the diagonal is to the right if the diagonal thread goes to the right, to the left if the thread goes to the left. The materials have changed a great deal in the last years in firmness and lightness and greater precautions are being made to insure tightness and to protect the fabrics against the different effects of the atmosphere. Consequently, there are several kinds of double-ply fabric of the same nature, but with different characteristics, which are expressed by a reference number. In the construction, the different reference numbers are distributed rationally according to the different parts of the balloon (*see Part II*).

Strapping.—Strapping is a hempen or flaxen fabric having a particularly great power of resistance and is made in narrow bands (*see Part II*). The band is manufactured in cordage works.

CHAPTER II.

MAINTENANCE OF BALLOONS.

I. General Principles.

In order to keep the balloon in good condition, constant precautions must be taken for the purpose of protecting the fabric as far as possible:

(a) From rubbing against uneven surfaces.

(b) From different atmospheric conditions injurious either to the fabric or to the coating of rubber:

Frost.—Injurious to the rubber and to the fabric, when it is damp.

Heat.—Injurious to the rubber.

The rays of the sun.—Injurious to the rubber.

Humidity.—Good for the rubber, but injurious to the fabrics as soon as it exceeds a certain degree and lasts a long time.

II. Maintenance of the balloon in the field.

As the balloon-packer on guard, the cutter specialist acts as the technical inspector of the condition of the balloon. In this capacity it is his duty to notify the commissioned officer of the guard as soon as the conditions of the field seem to be bad and to advise him what measures he should take.

(a) It is his special duty to see that:

(1) No part of the balloon, however small, is in the sun. The whole of the balloon should rest on the tarpaulin.

(2) That the tarpaulin itself is perfectly clean and free from all foreign substances (stones, branches). In order to do this it is necessary to see that the same surface is always turned toward the ground and that no one treads on the surface, in contact with the balloon, without canvas shoes with clean soles.

(3) The ballast sacks should not rub against the fabric as a result of defective hooking, nor rest on the part of the balloon which is folded up when the balloon is inflated. The hooks should always be fastened with the points turning outward.

(b) In the field it is impossible to withdraw the balloon from the influences of the atmosphere. The best that can be done is to lessen the effects of these influences, according to the balloon bed, that can be secured. *But very great precautions must be taken to prevent the serious damage which the frost can cause in the fabric.* The importance of these precautions varies in different cases: If the thermometer has gone down below 7°, no maneuver whatever should be engaged in, because below this temperature the cold affects the coating of

rubber and makes it brittle. If the balloon was damp at the time the frost affected it, no maneuver whatever should be engaged in, however low the temperature. If the balloon was *perfectly* dry before the frost and if the temperature remains above 7°, the fabric may be *manipulated in a normal way*, if precautions are observed, for the dryness is never perfect or uniform.

The cutter on guard should also constantly watch the condition of the fabric in regard to tightness and strength. He must pay special attention to the rigging band around the openings for the toggles. He must watch that they are not enlarged in such a way as to permit a lateral sliding of the toggle, which would endanger the firmness of the rigging, both as far as the fabric and the toggle itself are concerned. In a more general way he should watch the tightness of the fabric, which can be seriously endangered by the decomposition of the coating of rubber. This decomposition is revealed by certain exterior signs: By resinification, which can be recognized by the touch (the fabric becomes stiff and like parchment) and by the odor (an odor *sui generis*, slightly acid, difficult to define and which can be recognized only by practice). *The resinification can often compromise the very strength of the fabric.* It becomes greasy. This is manifested by the appearance of dark spots similar to oil stains and the diagonal pieces of fabric are loosened.

When the fabric is badly worn, it may also be as well to note the excessive thickness, sometimes important, which is made on the outside where the thread enters the fabric and glue a patch of fabric over it. In fact, in actual usage, the coating of rubber is pierced on a level with these places of excessive thickness.

III. Maintenance of the packed balloon.

(a) The balloon should not be packed in its bag unless it is provided with its cotton case.

(b) It should never be packed when moist, or, if it had to be packed through force of circumstances, the *first opportunity* for conveniently drying and airing it should be seized.

The packed balloon should be kept, as much as possible, in a *dry, dark and cool* place.

When it is freezing, it should not be manipulated unless the greatest precautions are taken and, except in the case of absolute necessity, it must not be manipulated in any way whatever when the thermometer goes below 7°, not even transported by wagon or by rail.

IV. Balloon inspection.

Balloons are inspected for the purpose of finding out their general state of preservation. Look for any small defects which they may have.

The inspection, which is made quarterly for the balloons in storage, is made for the balloons in the service before in-

flating them and, as a general rule, before using them and just before packing them. This last inspection is difficult to make in practice when the balloon cannot be inflated in the air and it cannot be subjected to the necessary airing.

In the storing depots the balloon is inflated with air but, in the field, the balloon is entered, simply spread out on its tarpaulins and it is raised gradually as the inspector passes on to look through the fabric. The squad which inspects the exterior guides him.

The inspection is divided into two parts:

1. *The inspection of the exterior.*—This is quickly made and the object of this inspection is to find important defects and to repair them immediately.

2. *The inspection of the interior.*—More minute. To make this inspection the inspection personnel is divided into two squads, one of which enters the balloon, while the other follows it on the outside, guides it, helps it and verifies the parts pointed out as doubtful and takes note of the repairs which are to be made.

The squad which is to inspect the interior of the balloon makes sure:

(a) That the envelope is in good general condition by methodically examining the panels. It points out all the holes, all the defects, all the places that show wear and tear and all the weak spots that it discovers to the squad which is to inspect the exterior of the balloon (it is to be noted that in balloons recently constructed, in which the fabric used is colored by means of a dyed coating of rubber, the slightest superficial scratch makes a very transparent place without seriously compromising the tightness).

(b) That the ripping panel is in good condition, that it is firm, that the *ripping cords* which control the ripping panel are fastened in a convenient way. These cords should not be very numerous. Normally, 6 or 8, passing twice through eyelets.

(c) That the hand controls of the ripping and the valve are conveniently arranged. These controls should not have any twists which would form knots while being pulled through and would prevent them from entering the sleeves.

CHAPTER III.

BALLOON REPAIRS.

The cutter specialist must always be able to repair any parts of the balloon which deteriorate either through use or through action of exterior causes and to execute correctly the urgent repairs which can be made without the materiel kept only in the parks and establishments of the interior. All repairs are made by sewing and by gluing.

I. Gluing.

The glue used is rubber glue, specially made of pure para, not vulcanized, dissolved in gasoline. It should be correctly used in order to get the great power of adherence of which it is capable.

The *essential* principle is to wait until the glue is dry enough before placing the pieces together. The proper degree of dryness can be determined by placing the hand on the glue. If the hand must rest for a rather long time on the glue to adhere to it and if it does not give a strong impression of freshness, which is caused by the rapid evaporation of the gasoline, then it is dry enough. Moreover, the evaporation can be hastened by rapid ventilation. Generally the gluing is done "in several layers" 2 or 3. As a general rule 2 for the parts which are stitched together, 3 for the parts which are only glued.

The object of the bottom layers is to form a foundation of glue, which is of such a nature that it permits the glue to penetrate it deeply and to form a perfectly homogeneous mixture, which gives the maximum adhesion. Therefore, it is *indispensable* to allow the bottom layers to dry perfectly before putting on the layer of glue proper, which is then put on by the method indicated below. *To neglect to take this precaution would be equal to gluing with a single layer of glue.* It is now important always to keep the fabric well stretched, but not too much.

In order to glue the gluing band of one-ply fabric (ordinarily called the "edging") which is placed on the seams to make them tight, it is well to roll it on a wooden roller about 25 cm. long, allowing room to guide it and preventing "mistakes," which are always bad, particularly in fabrics rubberized on the outside. The fabric should not be stretched too much when it is being glued. Particular care should be taken not to stretch the bands which cover the belt of the bagging down net, for, if the lower piece of fabric is lengthened, as a result of the work, the glue might be loosened and the band torn.

The "chien," which is to take up the excessive drops of glue around the part which has just been glued, should be

used judiciously, according to the fabrics which are used. Its use must be absolutely forbidden on rubberized surfaces and one must consequently be sure that the exterior has not been dyed by means of a coating of rubber, which is nowadays frequently the case. After gluing it is always well to cover it with talcum powder, especially if the glued part is exposed to friction against other parts of the fabric.

II. Stitching.

Stitching by hand, the only kind that can be used in the field, necessitates a correctness of execution which can be obtained only with patience and infinite care and a regularity which comes from great practice, allowing the eye to regulate the intervals between the stitches.

Correct position.—The needle between the thumb and the index finger, held as near the point as possible, the head of the needle against the thimble, which is placed on the middle finger of the right hand.

The fabric held in the left hand, between the index and the thumb, the nail of which should be as near as possible to the eye of the needle, to help it to pass through with a slight pressure.

Three kinds of stitches are generally used for this work: Baseball stitch, backstitch, saddler's stitch. Moreover, when two pieces of fabric have already been joined together, they are stitched with a very simple and well-known stitch, *the running stitch* (figure 15).

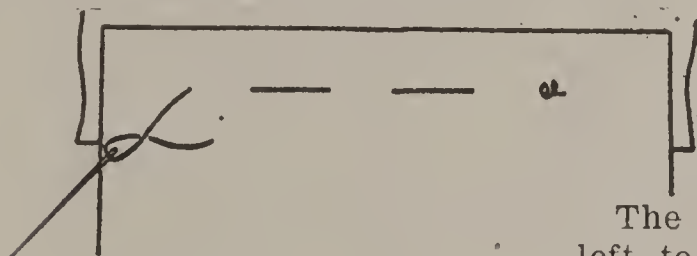


Figure 15.

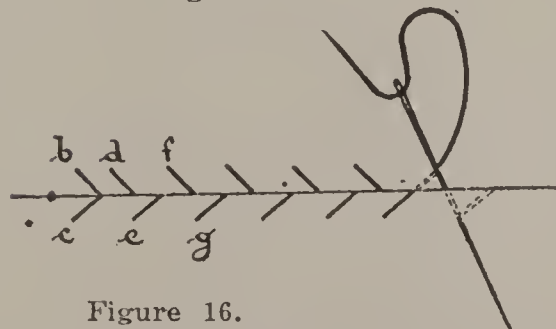


Figure 16.

The baseball stitch.

—The baseball stitch is used to repair a tear by bringing together the two torn edges.

The stitching is done from left to right, that is to say, away from the hand in which the work is held. To begin the seam pass the needle between the two edges of the tear and bring it out beyond the tear, about 2 mm. from the edge of the same (figure 16).

Pass the needle again between the two edges of the tear and *scw over from above* and bring the needle through at the distance of about 2 mm. and slightly in front of the first stitch. Pass the needle again between the two edges of the tear and *sew under from below* and bring the needle through at the distance of about 2 mm. and opposite the second stitch. These three stitches together form a kind of star and form

the beginning of the seam. The seam is continued in the same way, by sewing over and under, to the right and to the left, but in such a way that the stitches to the left correspond to half an interval of those made to the right. The seam is finished by a repetition of the star by which it is begun and thus, when it has been finished, it seems to have neither beginning nor end. When the seam is well done, the stitches are very even. The edges of the tear fit perfectly and there is not a fold or wrinkle in the fabric.

In an uneven tear, with curves or angles, the repairs are made in the same way as in the case of a straight tear, but following the outline of the tear.

Backstitch.—This stitch is used to join two pieces of fabric which are stitched together, one above the other. The stitching is done from right to left, after taking the precaution of tracing the seam with chalk, in order to place all the

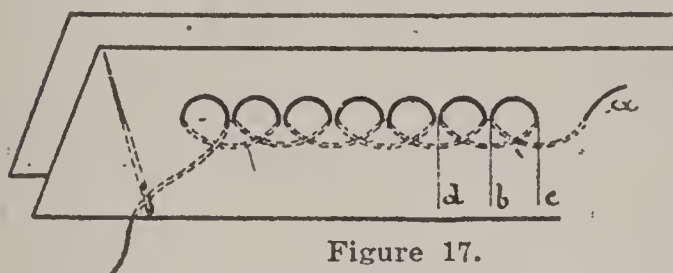


Figure 17.

stitches exactly in line. Stick the needle through on the guiding line at (a) (figure 26). Bring it through 4 mm. in front of the first hole through which the needle was brought on

the guiding line at (b). Stick the needle down between (a) and (b), 2 or 3 mm. from (b) at (c). Thus the first stitch is made. Stick the needle through at a distance of 4 or 6 mm. at (d). Pass it again through (b) (in the same hole, but in the opposite direction) and so forth. When the seam is finished, the threads are cut at the nap of the fabric. To join the ends of the threads in such a way that the darn may be invisible, the three or four last stitches are gone over with the new thread so that they overlap. A good seam should have stitches perfectly in line, at regular intervals and from 2 to 3 mm. in length.

Saddler's stitch.—The saddler's stitch is used in the construction of balloons only for stitching pieces which are made of strapping. It should preferably be done by a harness-maker, who is a specialist in making this stitch. Special materiel is used in making this stitch. A round awl, for the belt, two saddler's needles, waxed linen thread (the two needles are placed at the two ends of the same thread. The free end which comes through the eye of the needle is passed again through the thread, which is unraveled). If the stitches are not done by experts, a guiding line should be traced. The thickness of fabric through which the thread is to pass should be pierced by means of an awl (figure 27). One of the needles should be passed through the hole and half the length of the thread should be pulled through and, as a consequence, there will be an equal length of thread on both sides of the fabric attached to the needle. The fabric should be pierced at a proper distance along the guiding line. The two needles should be passed through the hole in

opposite directions from each other.

The thread should be fastened and so forth. The seam should be finished by going over the last two stitches with the ends of the thread, which is then cut at the nap of the fabric.

Threads.—There are four kinds of thread used in balloon repairs:

1. *Silk thread*, ordinarily used, in spite of the fact that it is very expensive, because it is very strong. It is used for all balloons except “calico” balloons.

2. *Scotch thread*, which is now used instead of the thread from Brittany. We have not been able to obtain the latter since the war began. It is a larger and stronger linen thread, used only for darning by hand.

3. *Cotton thread*, used only to make repairs in “calico” balloons (except the stars and collars, which are sewn with silk).

4. *Linen thread*, used to join the strapping.

Needles.—The needles ordinarily used are steel needles 0.025 m. in length and 0.006 m. in diameter. They are number 7 (short), of English make. We indicate the numbers of the different kinds, calling attention, however, to the fact that the assortment found at the present time on the market does not always conform to the following specifications:

Numbers.	Length.	Diameter.
6 long.....	0.0388	0.0007
6 short.....	0.0278	0.0007
5 long.....	0.032	0.0007
5 short.....	0.029	0.0008

Eyelets.—The cutter often has to sew on eyelets. The eyelet is inserted in a hole made by a puncher, then fastened by machine.

Numbers.	Diameter.	Principal uses.
309.....	0.004	Rigging band (lacing the toggles).
12.....	0.007	For the drainage orifices of the ripping panel and of the upper pads of the rudder. Fastening with an eyelet of the ripping panel.
15.....	0.010	For the orifice through which the air escapes when the balloon collapses (at the end of the lower pad and of the toggles). Sacks of B. C. A.

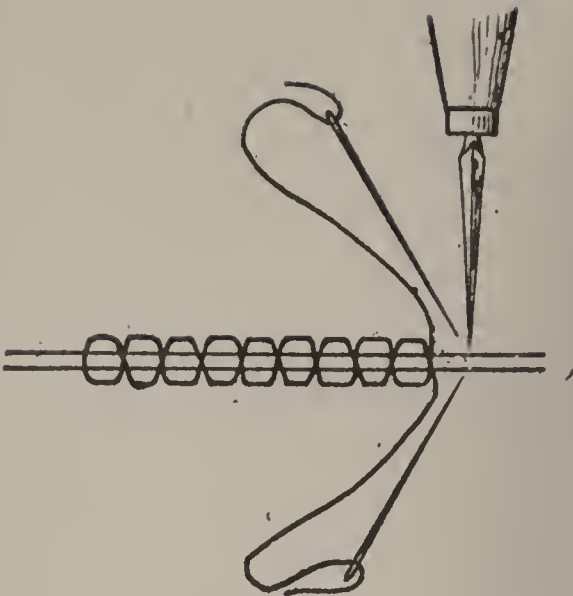


Figure 18.

Principal repairs to rubberized fabric.—The important repairs are made in the parks and establishments of the interior, which generally have a personnel well trained and skilled in construction and materiel for the construction itself and, for this reason, perfect repairs can very easily be made in these places. Most of the time only temporary repairs can be made in the field. These repairs are, otherwise, perfectly well made and strong.

Two cases are to be considered:

(a) The damage to be repaired had been found while an inspection was being made before the balloon was inflated and *the balloon was not inflated.*

(b) The damage had been done in service and *the balloon should continue to be inflated.*

A. The balloon which is not inflated.

The principal repairs to be made are: A hole, a tear, a piece placed on the envelope, a whole panel which is to be replaced.

1. *Hole with a small diameter.*—A patch of double rubberized fabric, having a diameter much larger than the hole, is glued over the hole. In doing this the rules for gluing given above are carefully observed. When it is possible to inflate the balloon with air, it is better to glue the patch on the inside.

2. *Tear.*—The edges of the tear are brought together by means of a baseball stitch. The seam is made tight (on both sides, if it has been possible to inflate it with air). The tear is covered by a double piece of fabric, having a larger surface than that of the tear. This piece of fabric is to be circular or rectangular in shape as the case requires. If the latter shape is used, the corners should be rounded. An edge of one-ply fabric is placed around the piece of fabric for the purpose of making it airtight and of preventing further tearing by lateral friction.

3. *Different pieces put on the envelope.*—As for these pieces, the detailed description given above suffices to indicate the way in which they should be put on in order to repair the envelope, if it is damaged, or to replace it, if it is useless.

In putting on a ripping panel, a simple but long and very delicate operation, the principal difficulty arises from the precautions which are to be taken against "the slack" resulting from an insufficient or irregular tension, which can cause the ripping panel to operate under bad or dangerous conditions.

In making common repairs guiding lines are traced on the ripping panel and care is taken, in mounting them, to make the patches exactly coincide with the tracings.

NOTE.—It is best to find the tracings made on the envelope when it was being constructed (they will be found at the intersections of the seams) and to make the tracings of the gore on them as a basis.

Of course, this operation can be made only in a balloon inflated with air. It is generally done in establishments of the interior and it is not wise to do this in the field except in case of absolute necessity. The work is done according to the following principles: A fabric of the same diagonal as that of the panel to be replaced is to be chosen. The bands, put on to insure tightness on both sides, are to be unglued a little beyond the edge of the panel which is to be replaced. The damaged panel is to be ripped carefully and *a stitch at a time*, in order to avoid damaging the overlapping of the panels next to it. The new panel is to be traced either on the damaged panel, using the latter as a pattern and reducing the dimensions from 0.005 m. to 0.01 m. per meter, if the fabric has been badly worn, or using the dimensions of the pattern, *leaving an edge* of not more than 0.008 meters for overlappings. The fabric should be moderately stretched while the panel is being mounted and glued in place in order to avoid the "slack" which might result from stretching the fabric of the panels next to it. It should be stitched with two rows of stitching 0.003 m. from the edge and 0.009 m. apart, airtight on both sides. It should be made airtight. It should be covered with talcum.

B. The inflated balloon.

When the balloon is inflated and in service the principal repairs to be made in the envelope itself can be made only by gluing, as stitching is almost always impossible. Moreover, these repairs should be made quickly in order to prevent the escape of gas. The only repairs which can be made are mending the tears and repairs made in the rigging band.

Repairing the rigging band.—When a bad or exaggerated movement of the rigging on the toggles has enlarged and stretched the fabric of the rigging band it is immediately re-enforced by a piece of double fabric which is glued on the edge. This piece of double fabric is rectangular, its corners are rounded and an opening of normal size is made in it. This piece should cover 0.05 m. on both sides of the edge and 0.05 m. on both sides of the damaged opening. It should be carefully glued with 3 *layers* of glue.

Holes and tears.—Holes are repaired by gluing a patch on the outside. To repair the tears the edges of the tear are joined as quickly as possible in order to prevent the gas from escaping. This is done either by joining the edges carefully over a piece of double-ply fabric which has a coating of glue and a surface area larger than that of the tear, or by gluing bands of single-ply fabric perpendicularly over the tear. Then a second piece of double-ply fabric, with a larger surface and circular or triangular in shape, with rounded corners, according to the shape of the tear, is glued with *three layers* of glue over the hole. The hole is edged with a band of single-ply fabric which is to insure tightness and to avoid further tearing through lateral friction. The principle to be followed, in

selecting the fabric for all these repairs, is to choose a fabric of the same diagonal as that of the panel which is to be repaired.

C. Varnished fabric.

Holes and tears.—Holes are repaired by means of small patches of varnished fabric stitched and then varnished. The patch should be placed in such a way that the direction of the threads are the same as in the fabric which is being repaired. The patch should be well stretched in order to avoid the "slack." It should be stitched 2 mm. from the edge of the patch. It should be covered again on the outside with a coating of varnish. In repairing tears the method of procedure is similar to that described for repairing balloons of rubberized fabric before they are inflated (a baseball stitch covered over again with a piece of varnished fabric, stitched with two seams, then varnished).

Putting in a gore.—The name "gore" (pointe) is given to the piece of fabric between two points of a crown of net (near the valve, or the neck of the balloon). Carefully rip and unglue the gore, taking care not to stretch the points of the crown of the net on which the gore is placed. Trace the new gore on the fabric, using the old one as a pattern. Baste with a running seam, stretching the fabric without pulling the crown of the net. Sew with a backstitch. Varnish.

Putting in a panel or gore.—The method of procedure is the same as that used for a panel of rubberized fabric, but an edge of 0.01 m. is left for the hook.

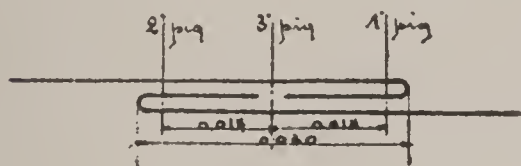


Figure 19.

The joining seams of balloons of varnished fabric give the effect of an arrangement called the "plain fell seam," which consists of two tucks of 0.014 m. joined end to end under the seam. We give as an example the hooked seam of the stationary observation balloon.

CHAPTER IV. PARACHUTES.

I. Description.

The parachute has the form of a round cap. It is composed of gores joined by a plain fell seam held by two rows of stitching. The fell seam is 0.015 m. wide and the rows of stitching are 0.009 m. apart and have from 3 to 4 stitches per centimeter. On the inside, between the seams, cords are drawn. These cords form the armature of the parachute and the points of attachment for the suspension cords (figure 20).

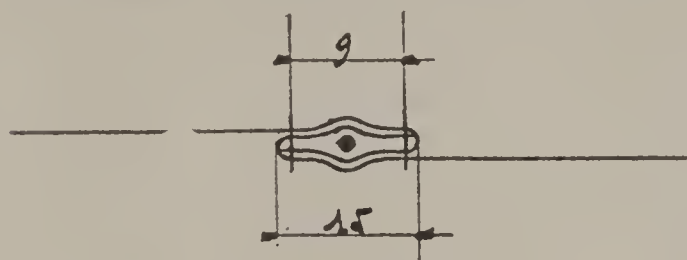


Figure 20.

The gores themselves are made of panels joined by plain fell seams. In the top of the cap an orifice is made. This orifice is circular and 0.50 m. in diameter and is made to allow the air to es-

cape during the descent. It is edged with a strap of rope (a) inserted through a washer of double-ply silk doubled again (b), which is reenforced by a washer of rubberized double-ply fabric (c). The whole of this apparatus is fastened on top of the parachute by means of three concentric rows of stitching (figure 30). On a level with the transversal seam, which joins the last and the next to the last panel from the bottom, a linen band 0.015 to 0.020 m. wide serves to reenforce the parachute all around and to prevent tearing when the parachute is opened. Eyelets, which serve as sockets for the interior ropes and the suspension cords of the pad, are placed at the ends of all the seams, which join the gores all around the edge of the circumference. A cord inserted in the edge, for the purpose of limiting the circular extension of the fabric, is fastened on the level of each eyelet by means of a button-hole stitch, thus dividing the stress on the circumference between the two eyelets. A hem 2.60 m. by 0.09 m., sewn along the edge, contains the inner tube. The function of this inner tube is to insure a quick and certain opening of the parachute. It is sewn at one end by a tongue-shaped piece of double-ply fabric doubled again and stitched and having three snappers, which surround the inflation valve. When at rest the parachute is encased in a truncated envelope of rubberized fabric (a), the bases of which are composed of circular blocks of three-ply wood (the method of folding, referred to in the special note¹ is strictly followed). The upper block (b), *small base*, is perforated along two perpendicular diameters with four perforations, through which the suspension cords (c) pass. The lower block (d), the *large base*, has two grooves

¹Plan of the note about the observation parachute (Meudon, July, 1917).

of 0.012 m., one at the very edge (*e*), serving as a bed for the bands which fasten the fabric to the block and the other (*f*), rounded, in which the elastic system of attaching the cover is enclosed. The body proper of the envelope ends at the circumference of the large base in a pad (*g*), made by means of a cord passed through the border. It has a circular support (*j*), made of special three-ply fabric like that used

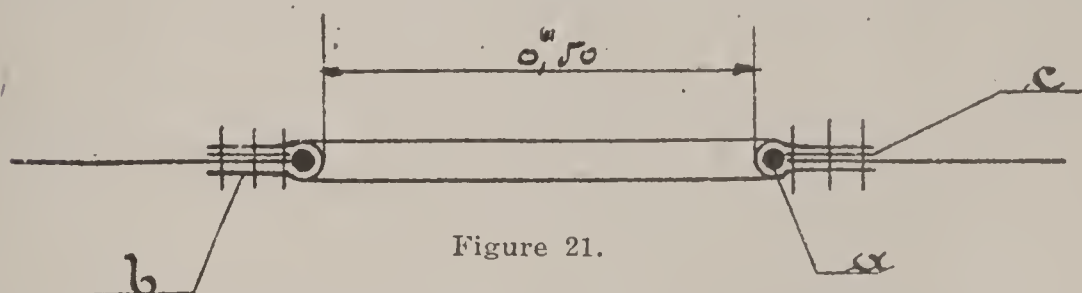


Figure 21.

for the face of deflating sleeves. The upper attached cap is composed of a cylindrical body (*h*), higher than the wooden block, notched toward the bottom and a base (*i*) composed of a disk notched around the edges and the notches of which are glued on the inner surface of the cylindrical body. The whole contrivance is fitted tightly around the block of wood and glued on the body of the envelope in such a way that the notches at the bottom of the cylindrical part cause a slight pressure under the block in order that the latter may be crimped in the fabric. Four perforations corresponding to

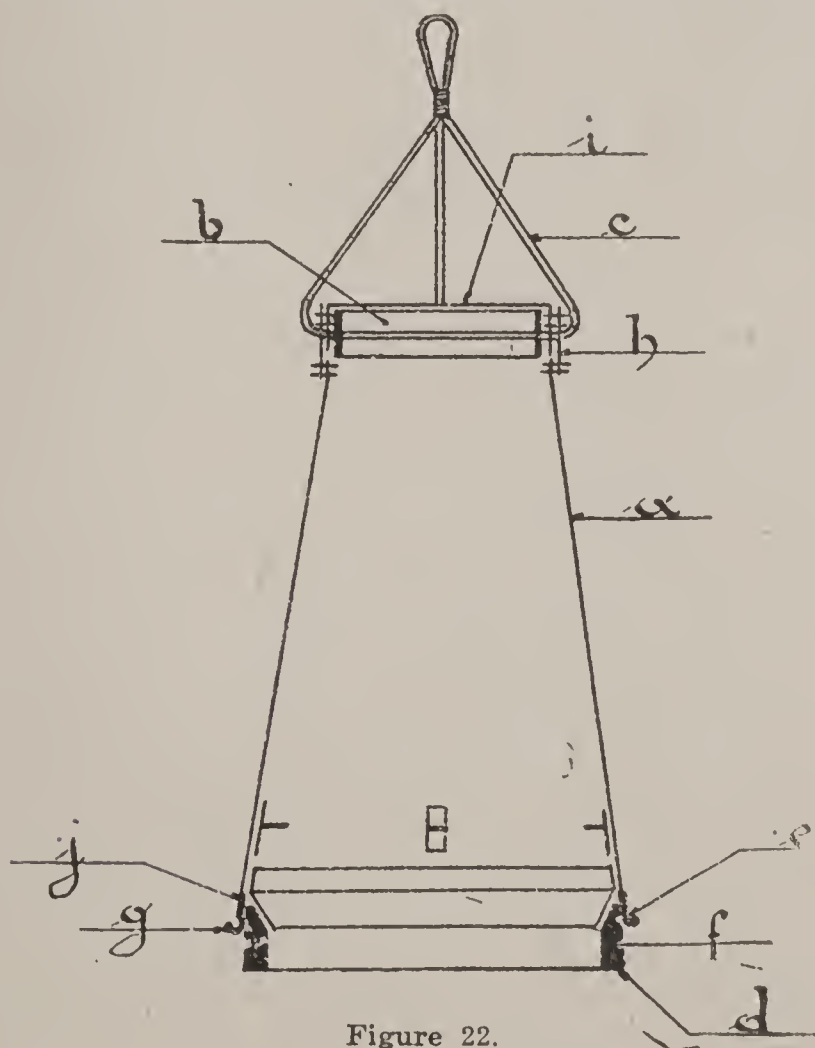


Figure 22.

the perforations of the block of wood are made in the wall. The lower movable cap or "beret" has a large pad on the circumference of its base. This pad has the spiral spring which constitutes the elastic joint. The pad is made from a washer which is notched on the inside along about one-third of its width. It is glued and sewn on the circumference of the cap,

which also is notched. The spring is inserted in the washer, which is doubled over it again in such a way as to give it a little freedom of movement. It is hemmed with a row of stitching. Two bands, crossed in the top of the cap, are attached along the two perpendicular diameters, in the border, around which they are doubled again.

They are fastened by means of a rectangular row of stitching, two diagonal crossed rows of stitching and two eyelets. An eyelet is made in them at the center of the cross bracing and opposite another eyelet, which pierces the top of the cap and, like the latter, permits the cord of the parachute to pass through.

The safety belt described in detail in the special note is made of strapping joined with a saddler's stitch, of elastic bands and of leather.

II. Fabrics Used.

The parachute is made of two kinds of silk fabric. Each gore contains two panels of French silk (one at each end), four panels of Japanese silk. The car is made of three-ply rubberized fabric. The attachment straps, fastened to the cap, are made of tubular strapping of specially great strength. The safety belt is made of hempen belting 0.053 m. wide.

III. Maintenance.

The principal precaution to be taken in caring for the parachute *is to be sure to protect it* against moisture. In fact, moisture takes away all the ripping resistance of the fabric. Therefore, *frequent and careful* inspections must be made, in a dry place and on a dry tarpaulin, there must not be the slightest trace of humidity. It is essential to see that the bag is airtight and to repair it carefully as soon as it seems to be damaged or worn.

IV. Repairs.

The repairs of a parachute are extremely delicate, because the apparatus itself is so delicate. The vital importance of the operation of the parachute seems to demand that the repairs be made absolutely correctly and as, in most cases, a special set of tools, in the hands of experts, are necessary to do this, one must make it a rule to forbid, as a general rule, making any repairs to the parachute itself on the spot, but to send it to the establishments of the interior when it is damaged. Repairs should be made on the spot only in case of absolute necessity and they should be entrusted only to a specially careful and skilled cutter. The detailed description of fitting the parts together, which are given above, suffices to indicate the rules and precautions which are to be observed in this case.

CHAPTER V.

I. MISCELLANEOUS MATERIEL.

We shall discuss only the materiel used at the present time for elongated captive balloons. The balloon is packed in a "casing" of cretonne 4.50 m. by 4.50 m. and a very strong "sack" of heavy hempen or linen cloth 1.75 m. by 1.40 m. by 0.60 m., called the "sack for the elongated captive balloon." The sack is closed by means of pieces of fabric, turned in and on the edges of which eyelets are made for lacing. These eyelets are No. 15. A strap (of the type of the bagging down net), on which 10 handles are sewn, using the saddler's stitch, 3 on each side and 2 at each end, forms a belt around the circumference of the sack about half way up and serves as a handle. The seams are made with Scotch linen thread (on the sacks formerly used there were only 6 handles, 3 on each side, formed by a cotton tape run through leather washers, forming eyelets).

II. Materiel Used for Inflation.

It includes:

Inflating-canvas.—Of hemp, 14 m. by 14 m.

Inflating sleeves.—0.28 m. in diameter, of double-ply rubberized fabric, with special straight thread. They are made in three different lengths, 5, 10 and 20 m. The sleeves are turned inside out and are sewn with two rows of stitching. The first row of stitching joins the two edges, allowing the lower piece of fabric to project several meters beyond the

upper. The first seam is about 0.012 m. from the edge of the latter. Then a hem of 0.01 m. is made and the hem is sewn by means of a row of stitching on the edge previously left (figure 32).

The *i n l e t*.

Figure 23. through which the balloon can be inflated simultaneously, with two gas supplies, is made by joining the two parts of the sleeve to the end of a short sleeve of about 1.10 m., in the way illustrated by figure 33.

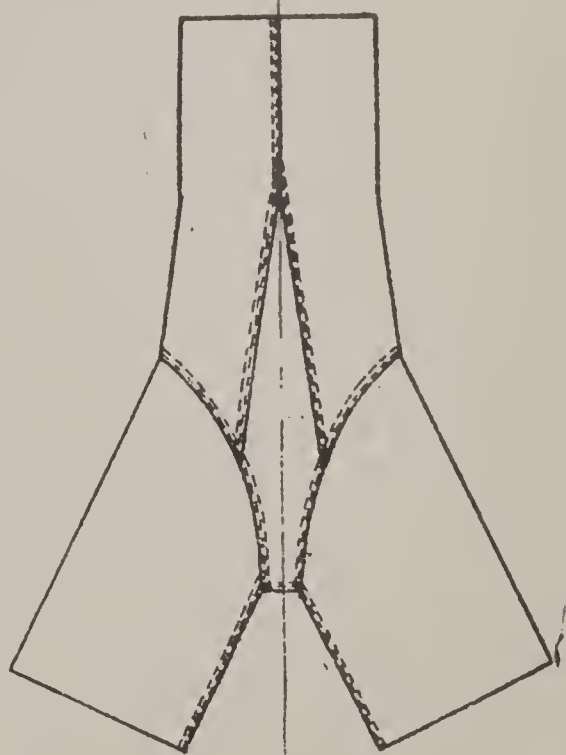
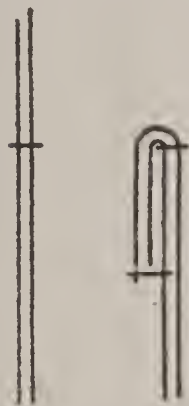


Figure 24.

III. Materiel for Use in the Field.

Tarpaulin.—Of hempen cloth or of linen, 25 m. by 8 m.

Ballast sacks of hempen cloth.—The bottom is sewn by two seams, made by the same method as that described above for sewing the inflating sleeves.

Balloonist's tent, 1915 model (figure 34).—This tent covers a surface area of 5 m. by 5 m. It is made of panels of rubberized canvas, joined with overlapping of 0.03 m., by two rows of stitching 0.02 m. apart. A rubberized band of strapping, of about 0.06 m., doubles, on the inside, the longitudinal rows of stitching of the roof and binds the ends.

The tent has the following parts:

(a) An entrance covered by entrance flaps raised up and fastened by means of 14 loops on the inside and on the outside (6 loops on the outside and 8 on the inside).

(b) Four windows, two on the wall opposite the entrance and two on the sides. They are made of oiled calico. The frame of the entrance is edged with bands of strapping, with cross-pieces of narrower bands of strapping. The oiled parts of the side windows are movable, they are fastened at the top by a seam, at the bottom and on the two sides by 9 loops fastened on the outside. They may be raised by rolling them up and they are held in this position by two thongs from the inside and fastened on the outside.

The tent is pitched on 12 bamboo tent poles: One central tent pole in two parts, joined by a metal socket, nine tent poles, of the smallest kind, which support the sides, two tent poles, which hold the entrance panels open.

At the top of each of the tent poles is a wooden plug into which a round-headed screw is placed, projecting about 0.05 m., and, at the bottom, is a four-cornered pointed piece of wood, which is inserted into a movable metal plate 0.15 m. by 0.15 m., with a hole in the center. The object of this plate is to make the pole firmer. The tent is supported by 13 cords provided with adjustment runners of wood and fastened by means of loops with holdfasts.

These cords are attached at the bottom of the roof: Two on each side of the entrance flaps, three at the middle of each side, eight (4 pairs) at each corner. They are fastened by means of a loop sewn on the fabric and the strap which edges the roof. A leather washer, sewn on the inside, strengthens the place where they are joined. A second leather washer, sewn on the outside, covers the loop and fastens it, with its stitching, where the splicing begins. This washer has an eyelet, No. 15, into which is inserted the round-headed screw on the top of the tent poles. Around the bottom of the walls, about 0.25 m. from the edge, is placed a kind of belt, the upper edge of which is fastened by two rows of stitching. It serves to stretch and stiffen the walls. It has 31 eyelets, through which pass the small cords which are attached to the anchor

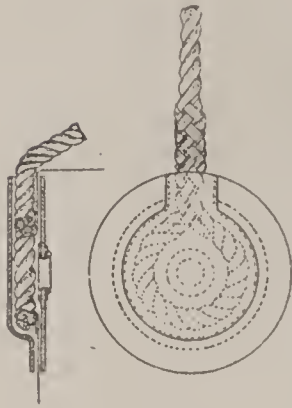
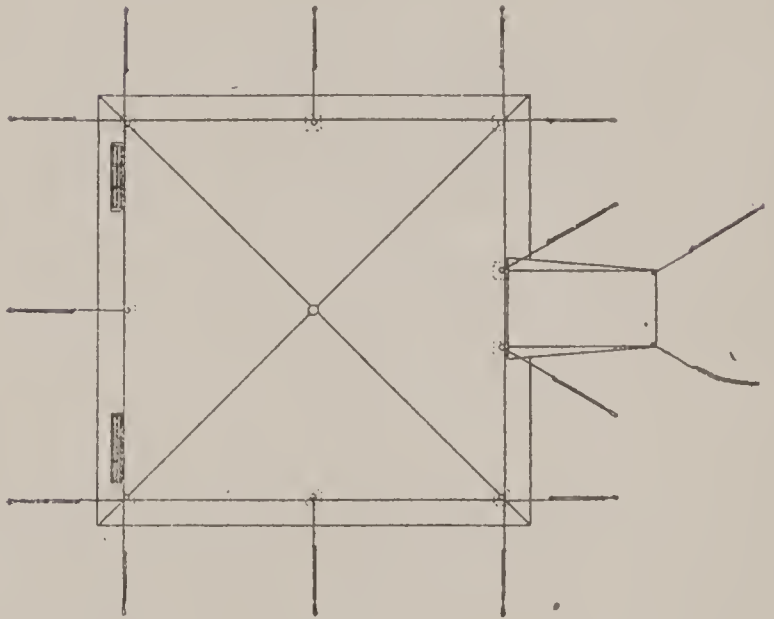


Figure 25.
Details.

pegs. The eyelets are placed: Six on the surface which opens, seven on every other surface, one at each corner.

The tent is folded and placed in a sack of rubberized cloth.

The tent pegs are packed in a larger and narrower sack, which also holds the metallic plates and the 3 spare tent poles.

Tarpaulin for the basket.—These are rectangular pieces of strong hempen cloth (of the type used for the inflating canvas), which have a hem made by cutting a diagonal slit in the fabric at each corner and then sewing it again. The edges are provided with eyelets for lacing, four on each hemmed surface and three on each of the others. The two models in use are: The tarpaulin for the basket, holding two observers, 1.35 m. by 1.35 m. The tarpaulin for the basket, holding one observer, 1.35 m. by 1.05 m.

Valve cover.—The fabric valve cover is made of five layers of double-ply fabric, covered again on the inside and on the outside with single-ply fabric. It is in the shape of a round cap on a low cylinder and has a hole at the top. This hole is about 0.03 meters in diameter (figure 25). It is constructed on a wooden mold. A notched belt is joined by means of a washer glued on the notches. Five other concentric washers, each with a smaller diameter than the last, are placed side by side and united at the top of the cap by means of a small disk.

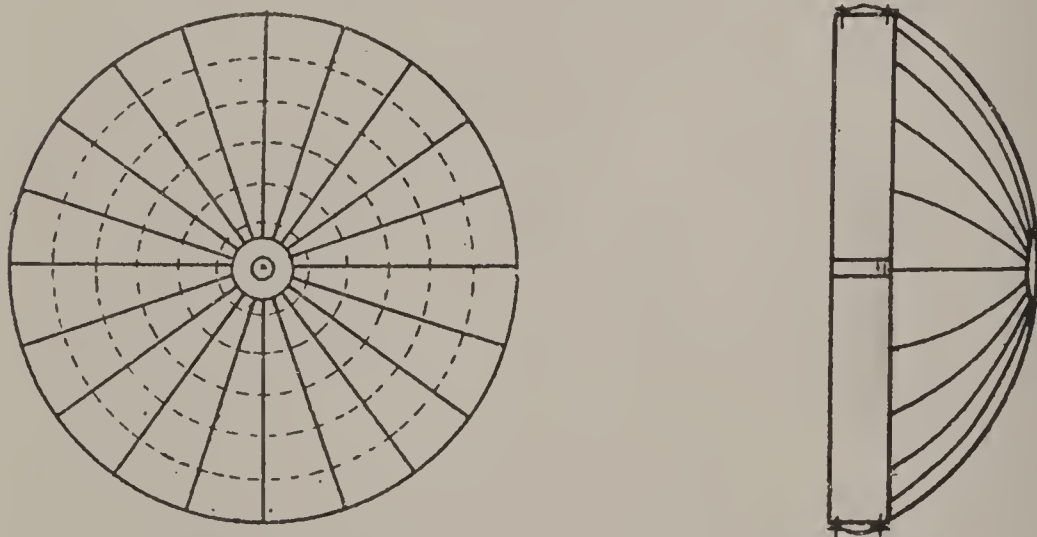


Figure 26.

A cover is placed on these washers. The cover is made of triangular gores placed side by side. The tops of the gores are joined by a disk. The cover or cap, thus prepared, is turned inside out and 3 successive layers of gores, joined at the top by a disk, are put on the inside. The inside and outside are covered by fabric, in gores with disks and a belt, a repetition of the central layers.

Work tent for the tool truck (figure 27).—It is a tent shed made of canvas. It is attached by its upper edge, which is provided with eyelets, to the sides and to the rear of the

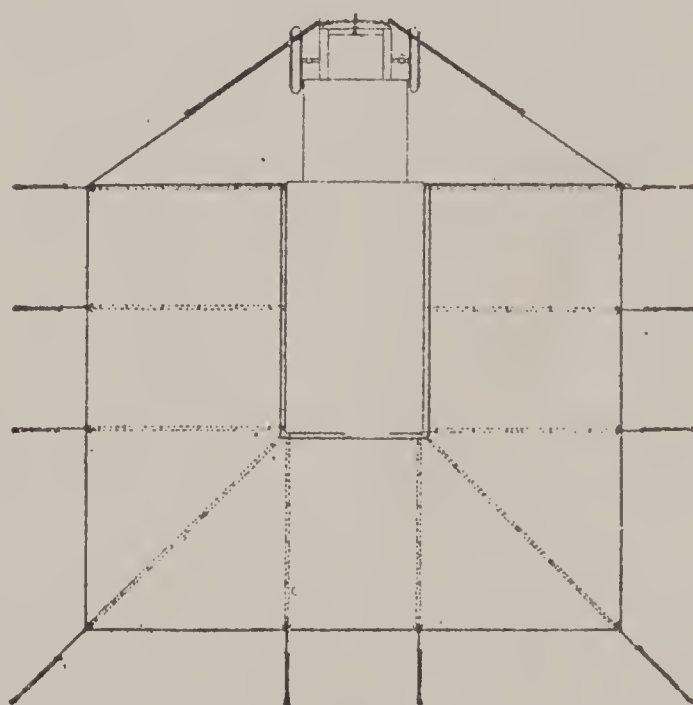
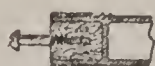
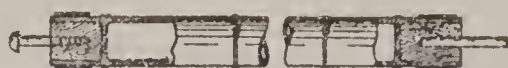
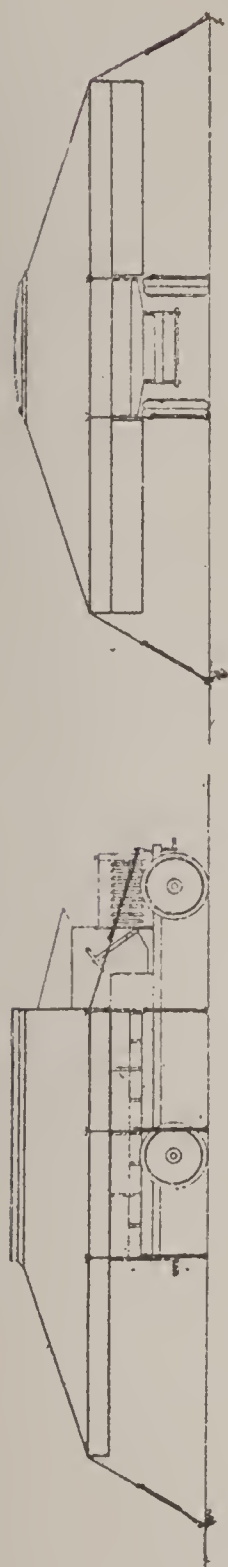


Figure 27.
Variation.

truck, which has a wooden footboard for this purpose. On the footboard are round-head screws (a band of fabric, fastened by snap-fasteners, covers the eyelets in order to insure tightness). A lateral projection shelters both ends. Ten bamboo poles, with a plug of wood at both ends, serve to support the shed. At the upper end of each pole, in the plug of wood, is a round-head screw and at the bottom is an iron spike. The round-head screws are inserted in one of the three eyelets, fastened opposite each pad, on the fabric and used according to the tension. The spikes are fastened into the sides of the truck.

The tent is supported by cords attached to the tent by means of a V-belt with a ring. These cords are attached to the tent pegs driven into the ground by means of loops and their length is adjusted by means of wooden runners.

IV. Materiel for Making the Ascension.

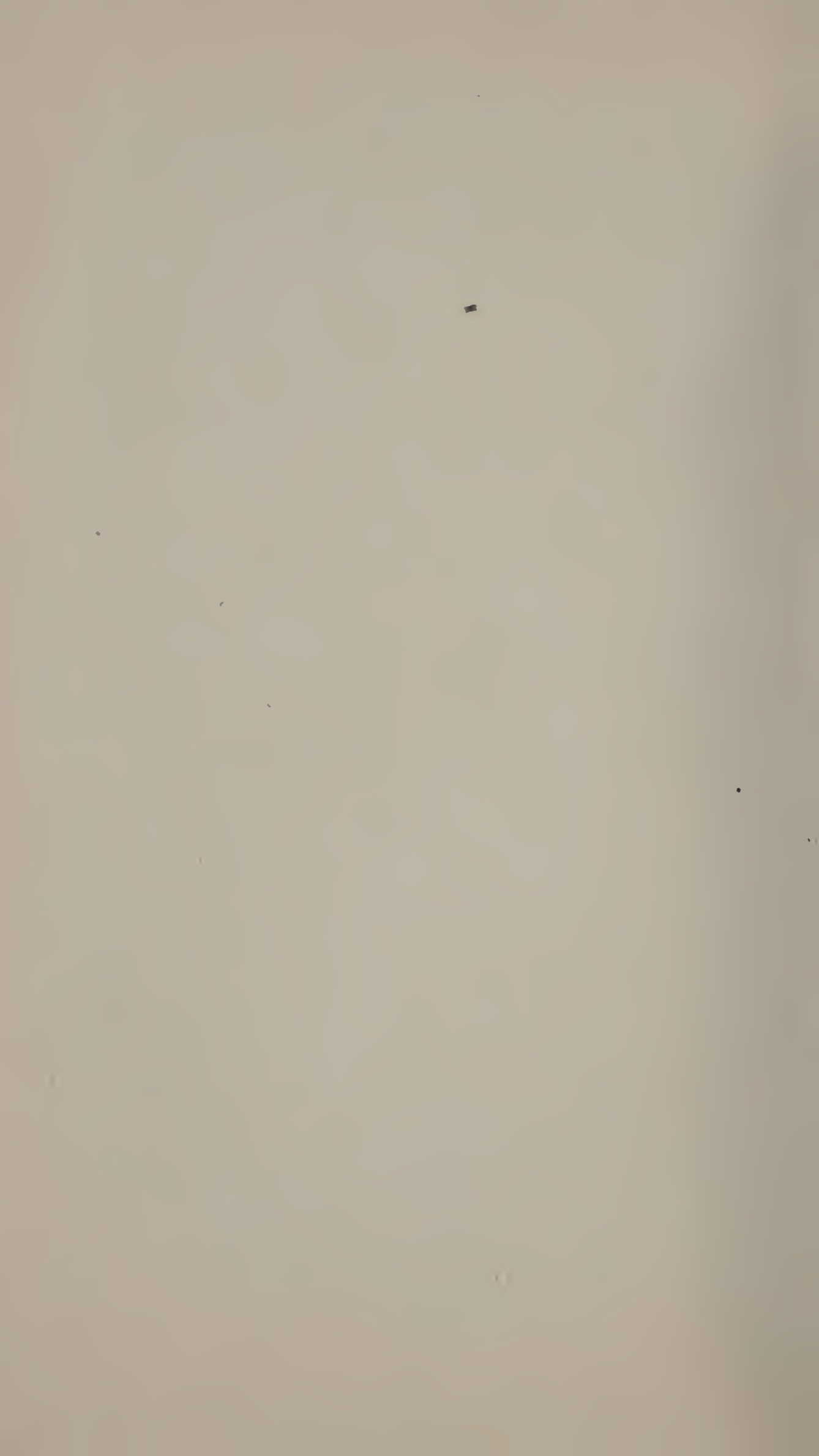
Furnishings of the basket.—The inner walls of the basket are covered with double-ply rubberized fabric. At breast height there is a pad stuffed with kapok. On the sides are one or two pockets for documents and for instruments.

Basket cushion.—Of one-ply fabric, stuffed with kapok and, with small patches of leather, make it more comfortable.

Carpet for the basket.—A velvet pile carpet with a border.

Tricolor flag.—Of wool bunting or cotton fabric, 3.30 m. by 1.80 m.

Pennant.—Of wool bunting or red cotton fabric, about 5 m. by 0.25 m. The "arrow" is 0.50 m. in length and the two points are weighted with lead.





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